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Gaarder et al.

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(54) **SHEET FEEDER WITH MODULAR ROLLER SUPPORT AND DRIVE ASSEMBLY**

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(51) **Int. Cl.**[7] **B65H 3/06**
(52) **U.S. Cl.** **271/117**; 271/121
(58) **Field of Search** 271/117, 118, 271/121, 122

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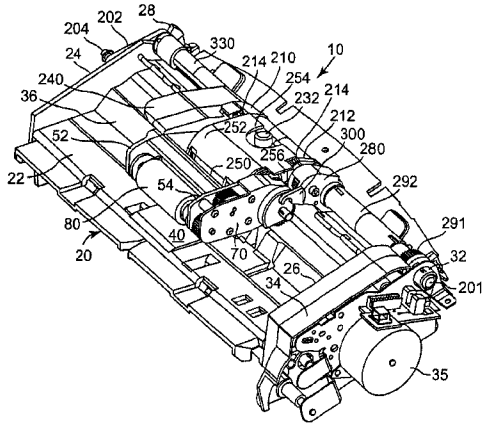
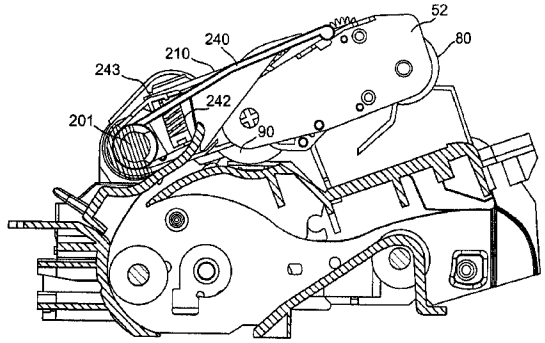
Primary Examiner—Donald P. Walsh
Assistant Examiner—Joseph C Rodriguez

(57) **ABSTRACT**

A modular single sheet feeder for feeding media sheets to a processing apparatus includes a chassis frame and a modular roller support and drive assembly pivotally supported on the frame for easy assembly. The roller support and drive assembly biases a roller frame which may be a replaceable bogie toward the media sheets to be fed and selectively positions the roller frame in a stack feeding position. A stack stop is provided for limiting the motion of the stack during manual loading and is automatically moved out of the media path as sheets are fed. Over engagement protection of the input gears and of the roller drive gears is also provided.

45 Claims, 18 Drawing Sheets





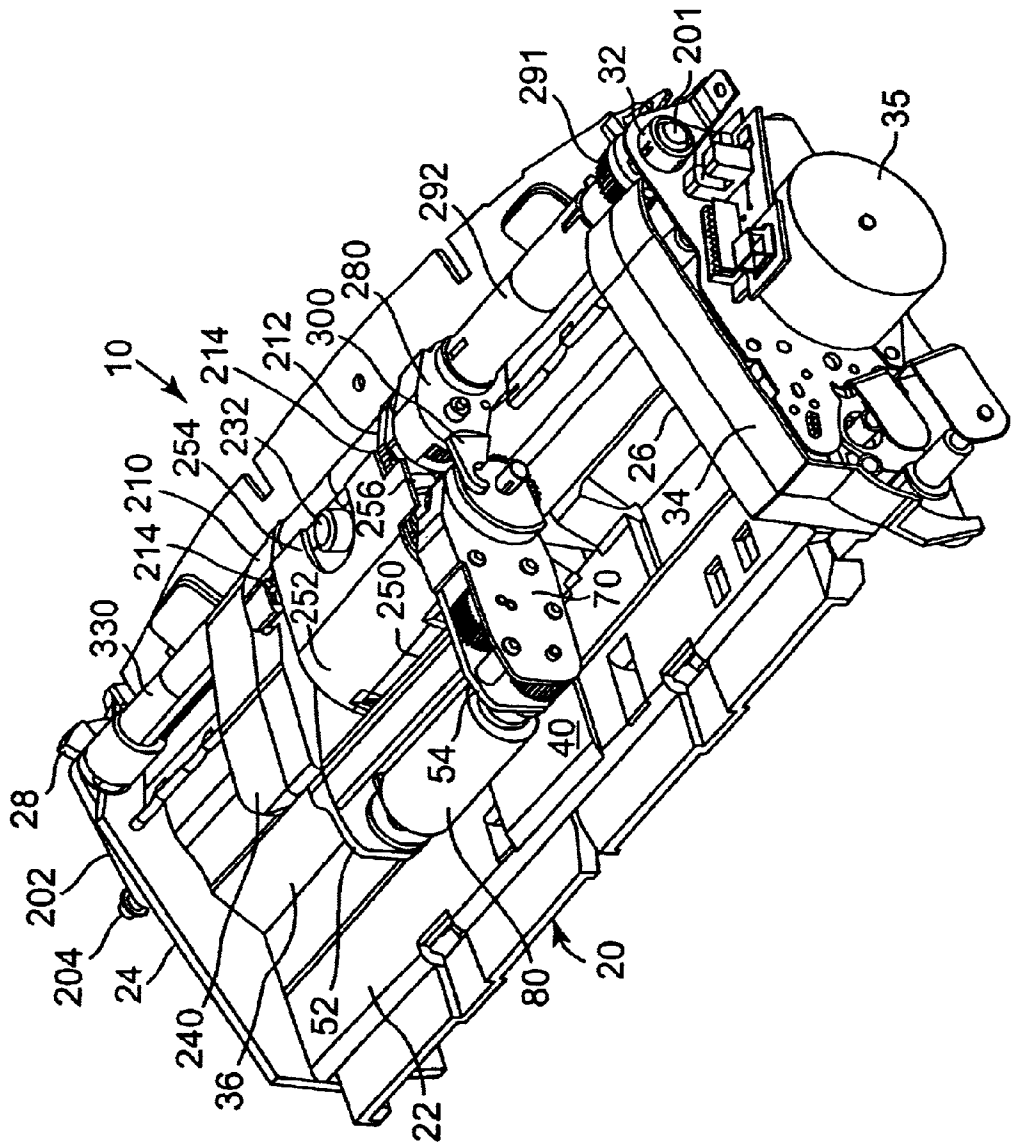

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Fig. 1

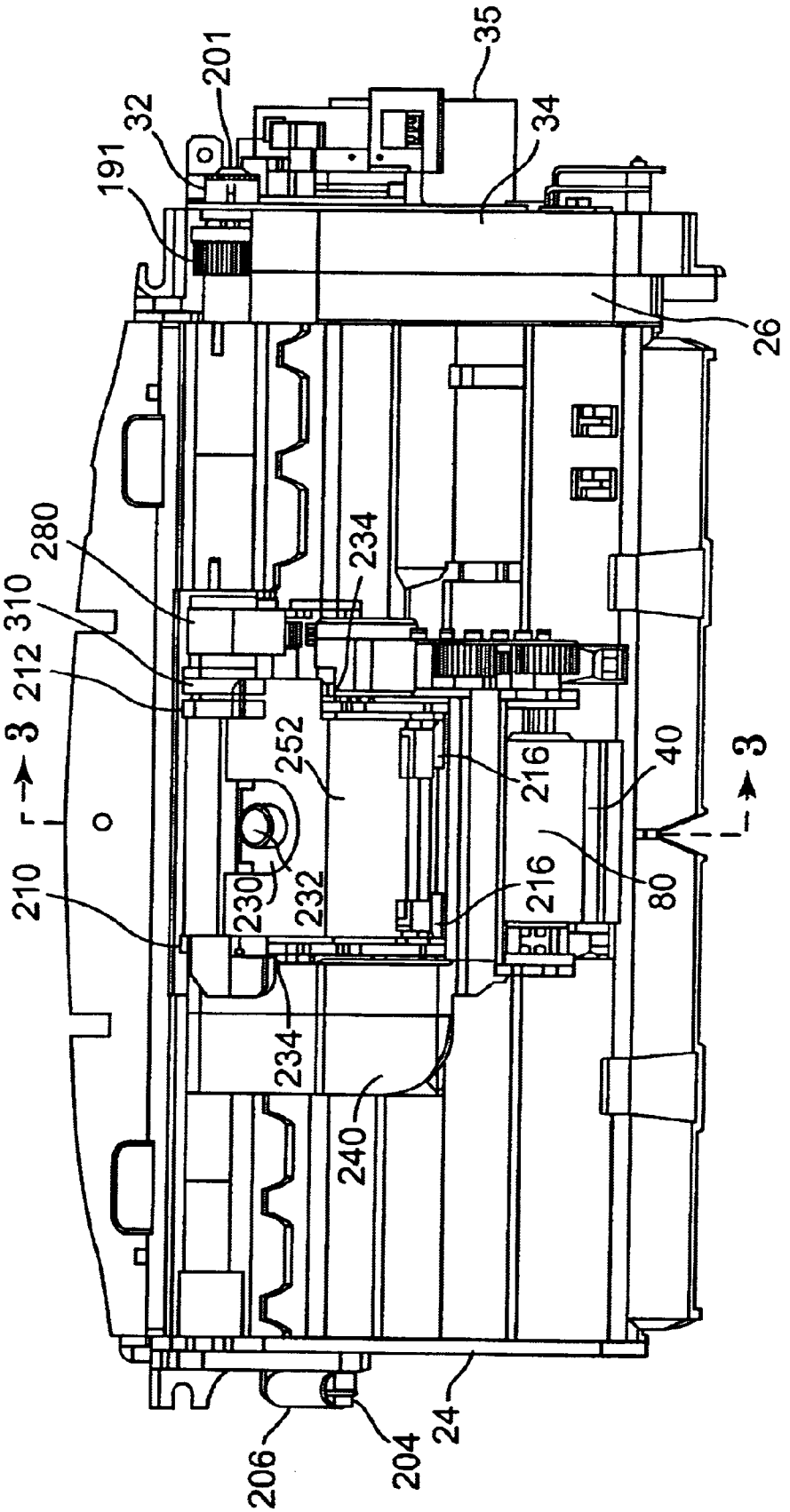
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Fig. 2

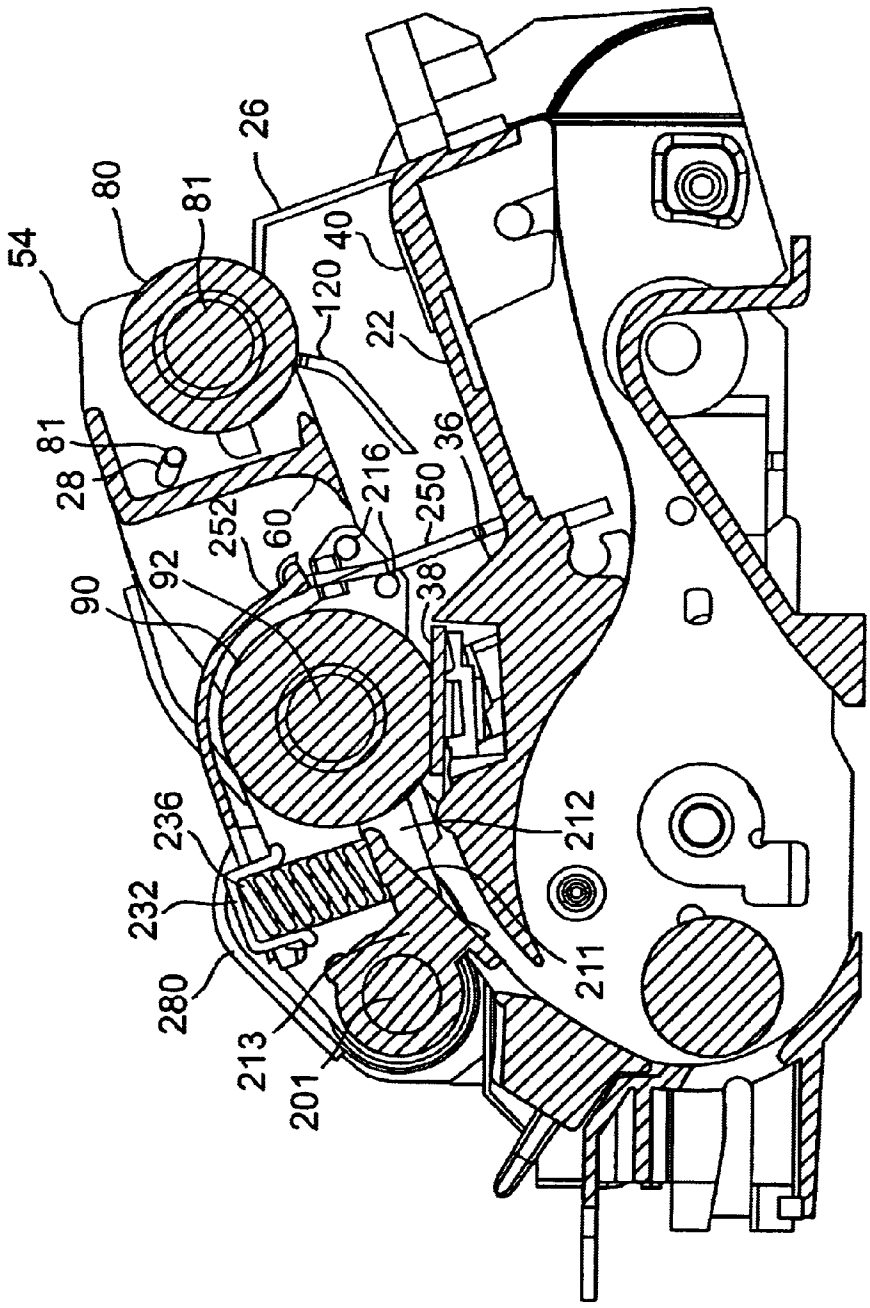
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Fig. 3

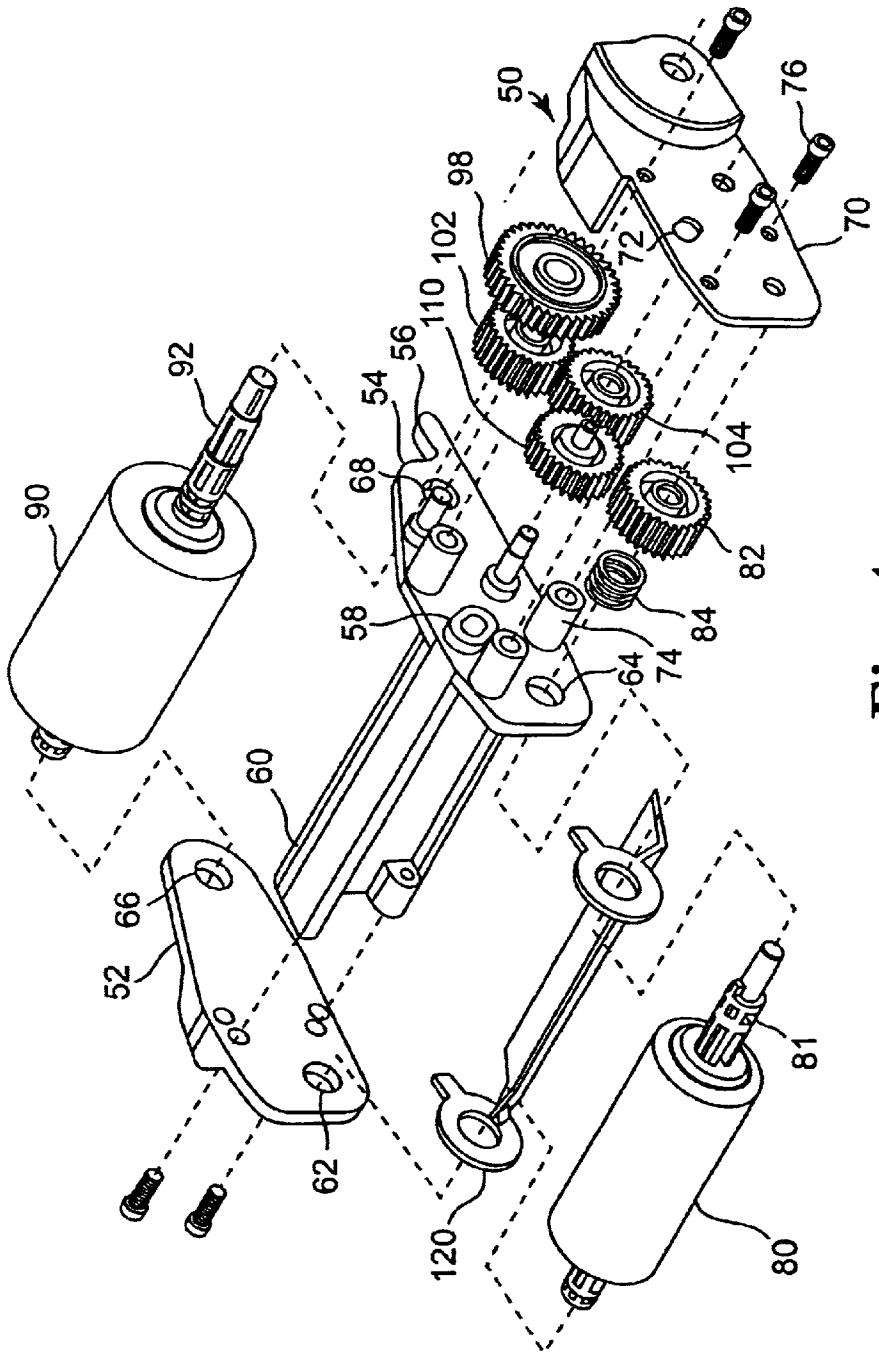
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Fig. 4

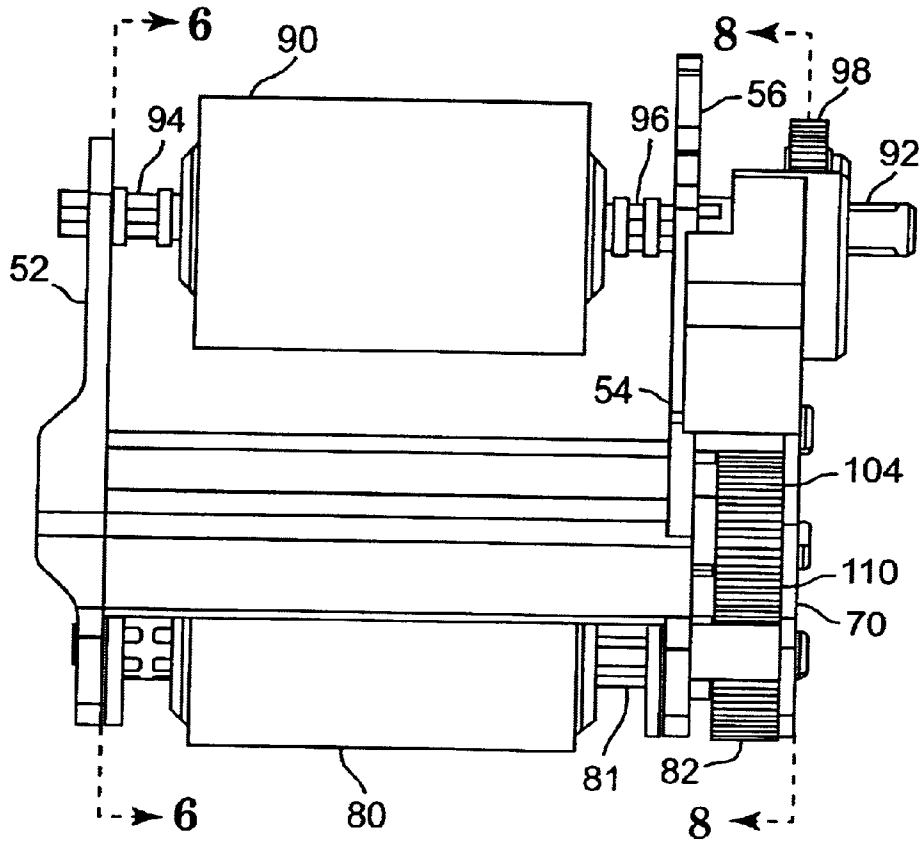

Fig. 5

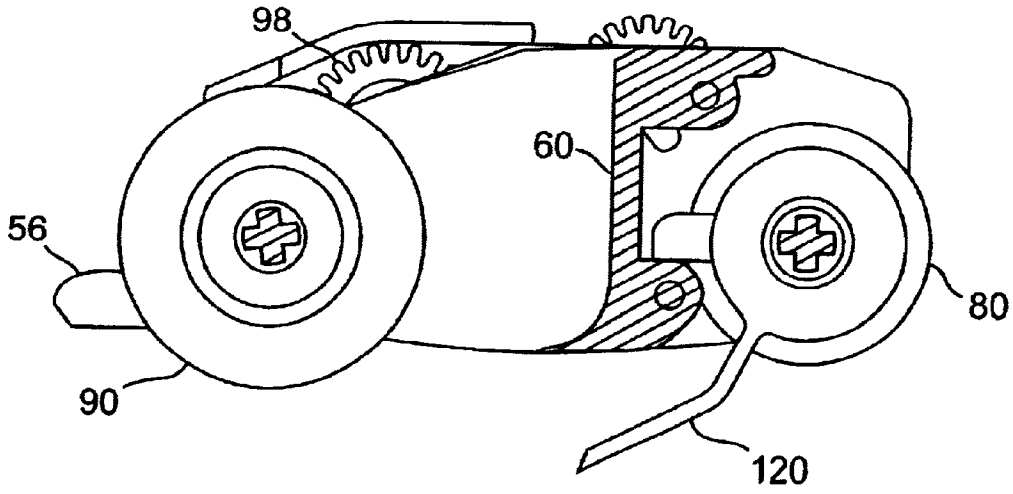

Fig. 6

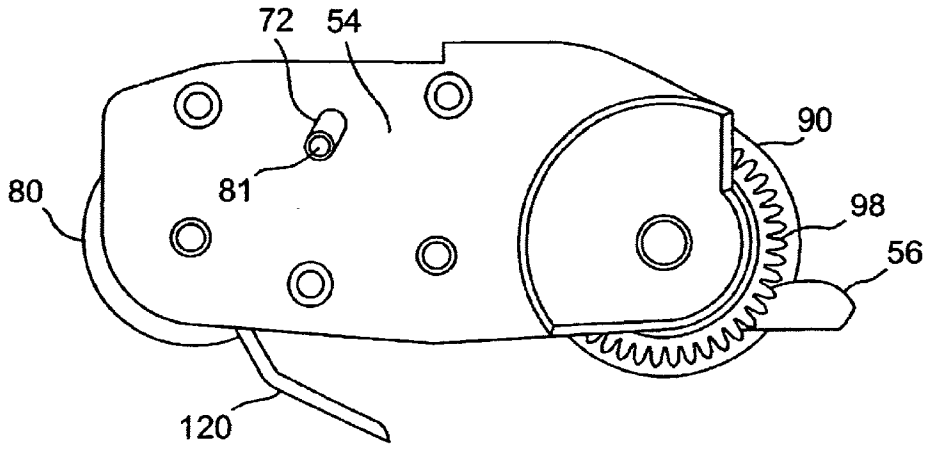

Fig. 7

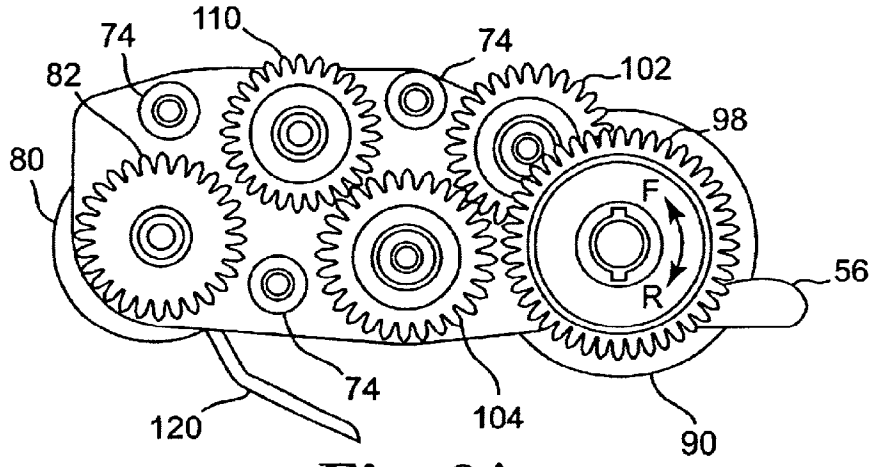

Fig. 8A

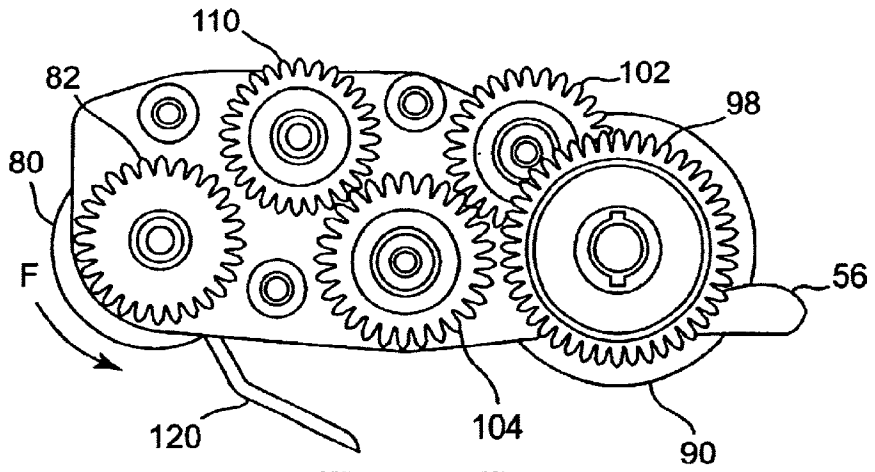

Fig. 8B

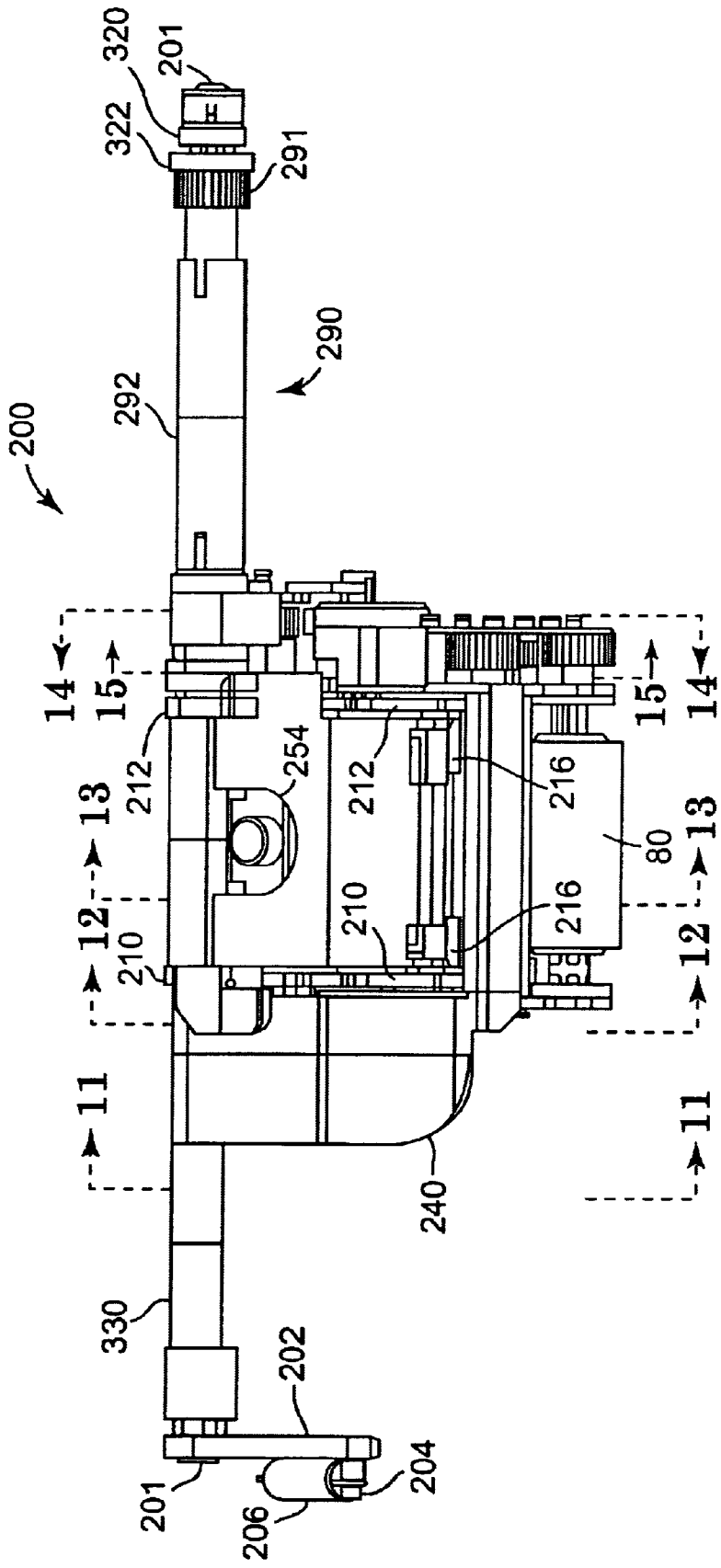
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Fig. 9

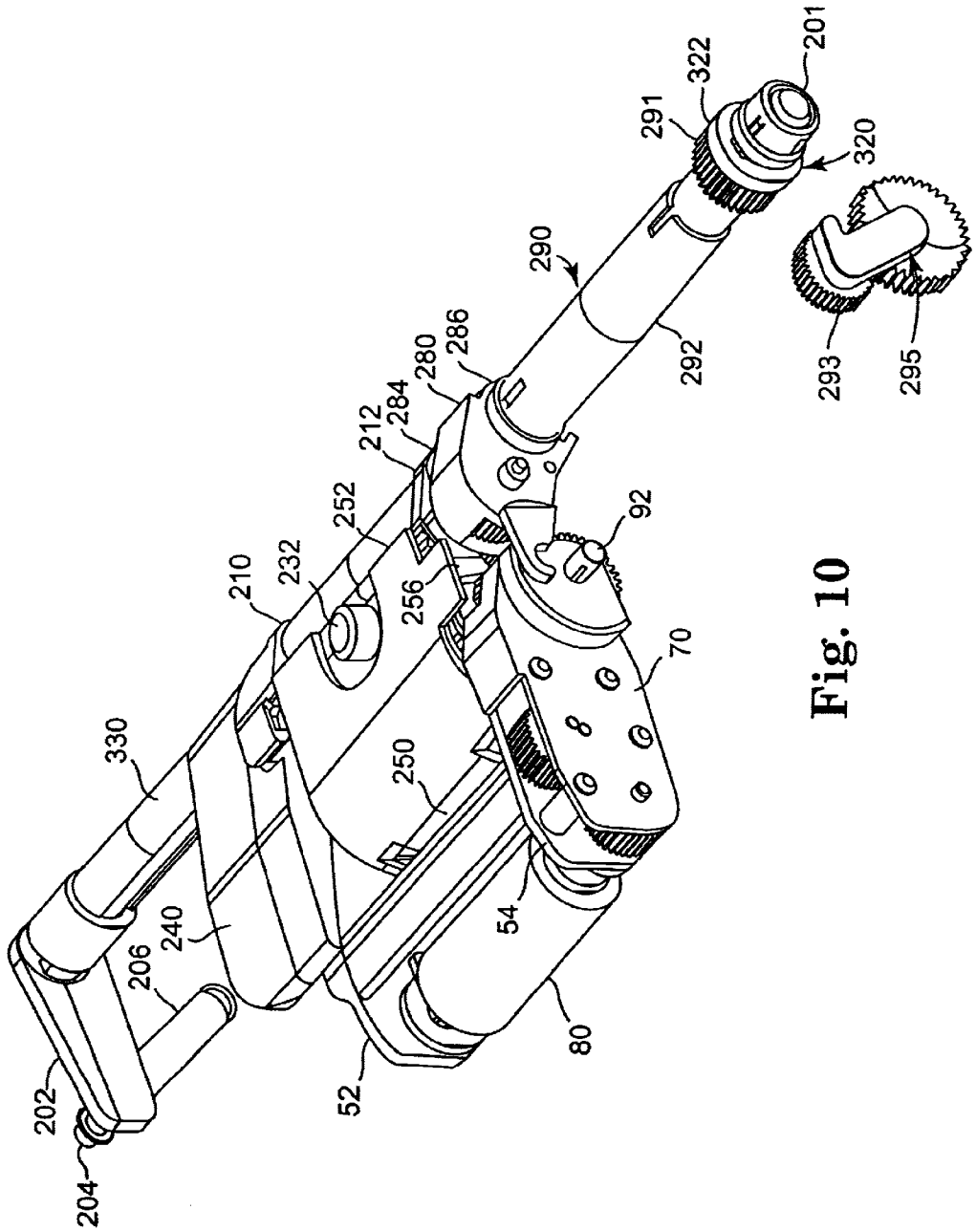
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Fig. 10

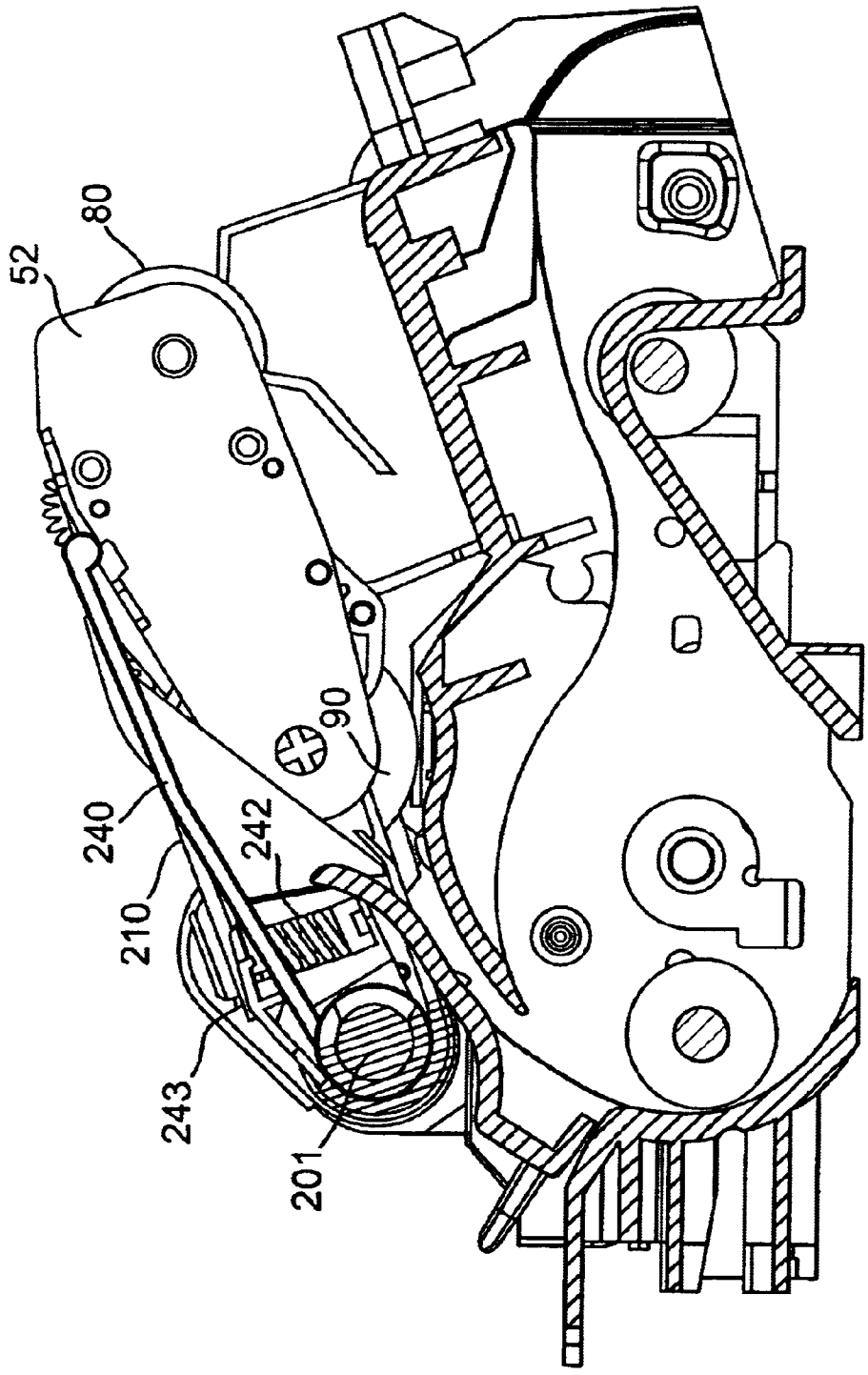


Fig. 11

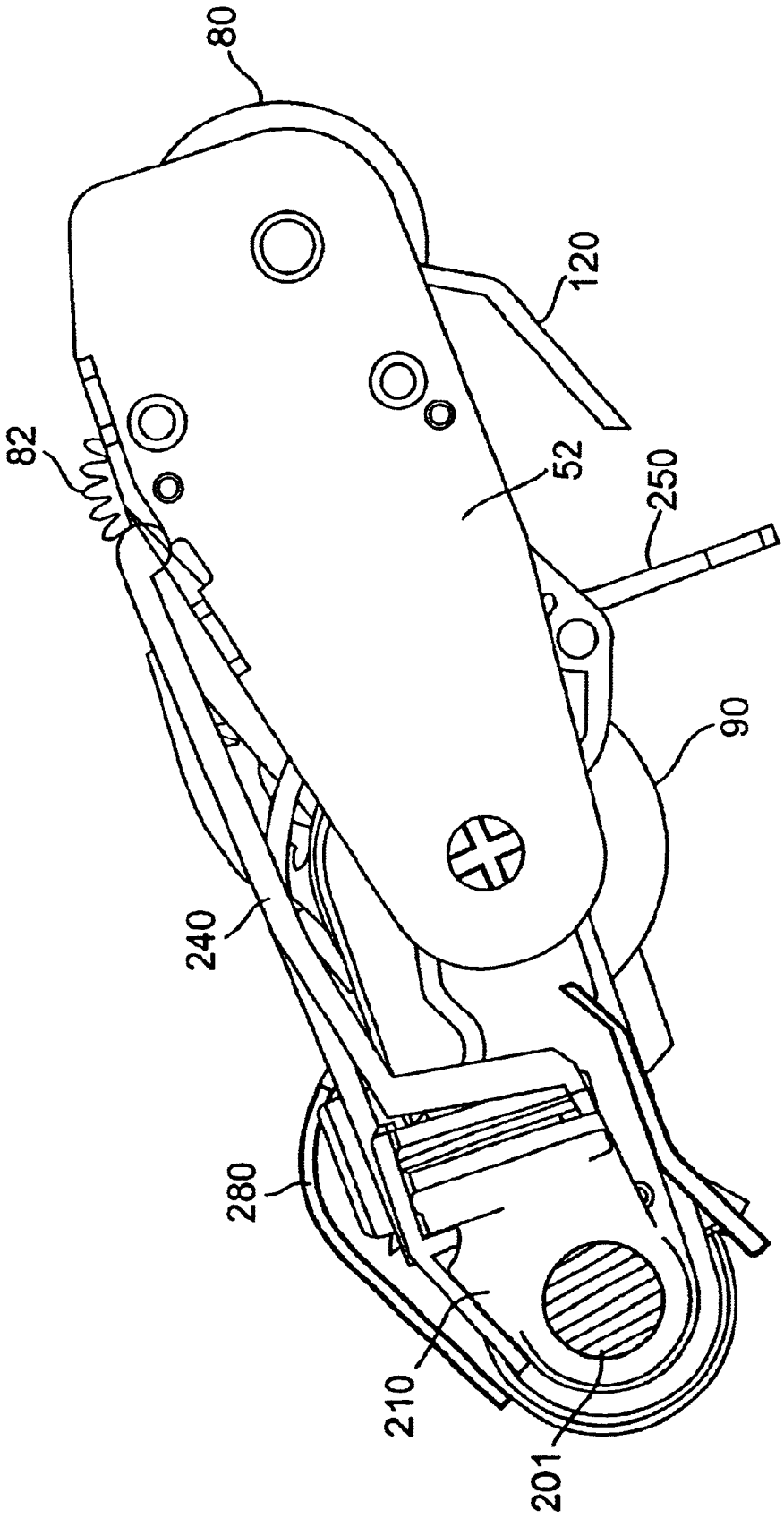


Fig. 12

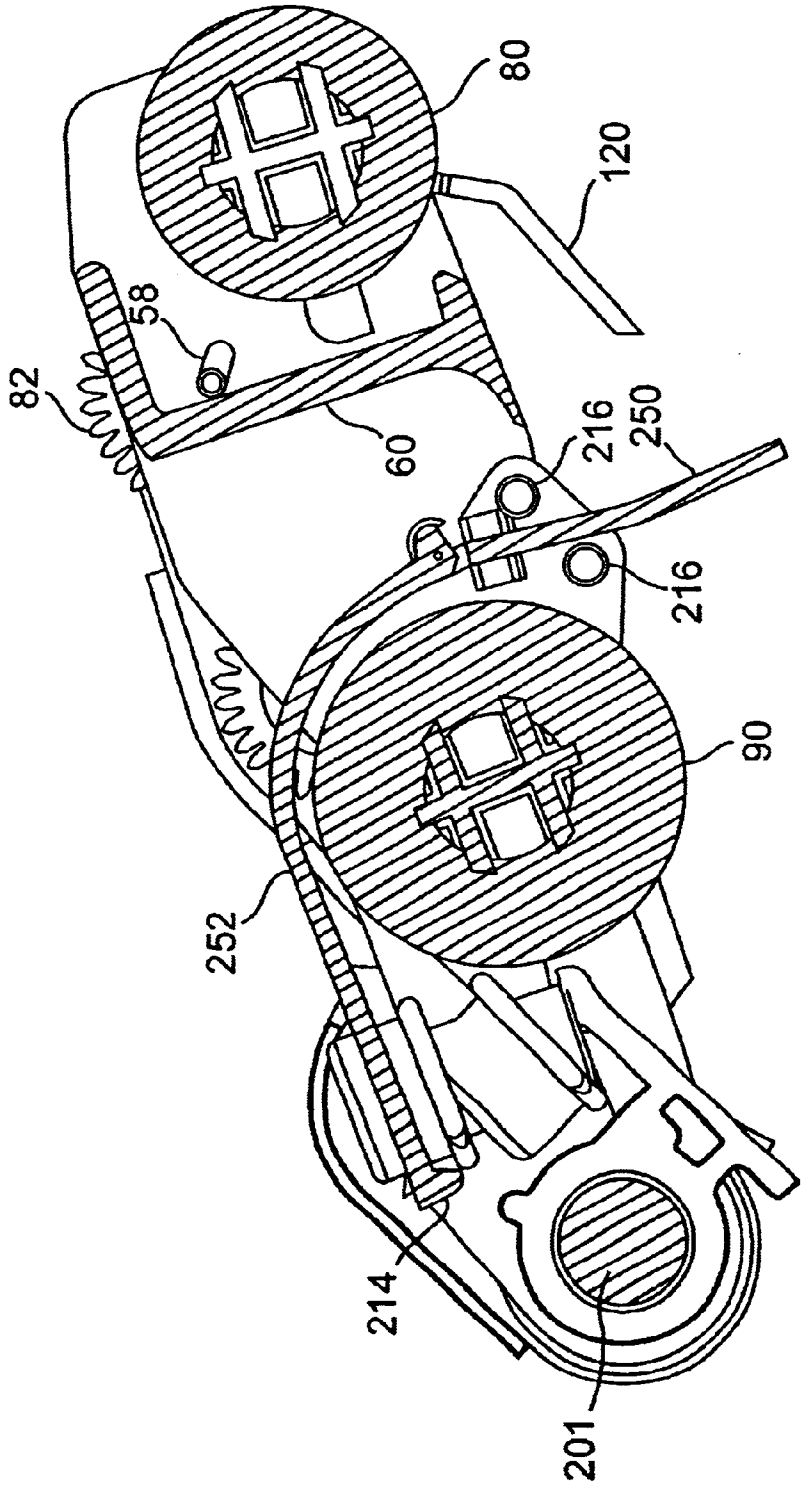
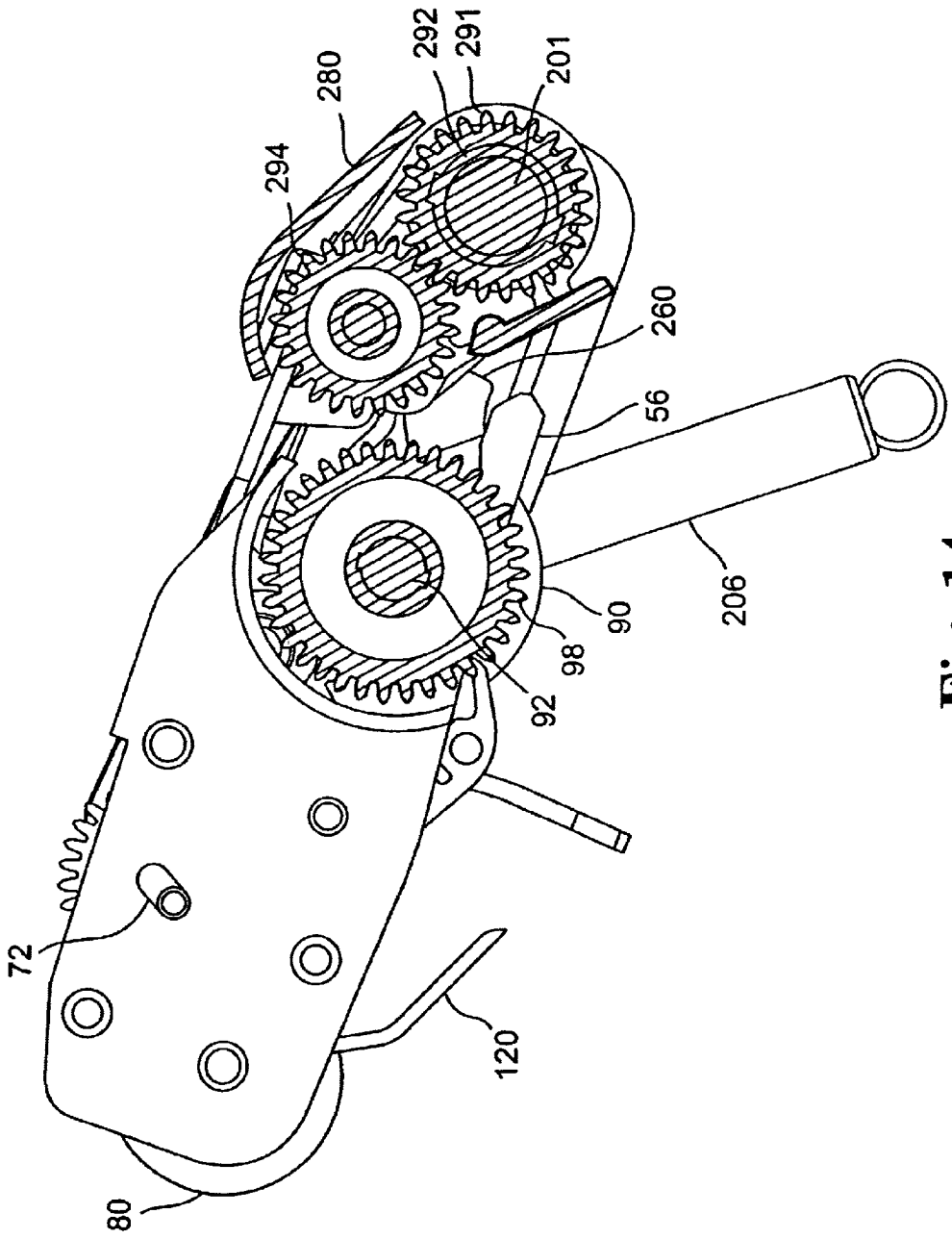


Fig. 13



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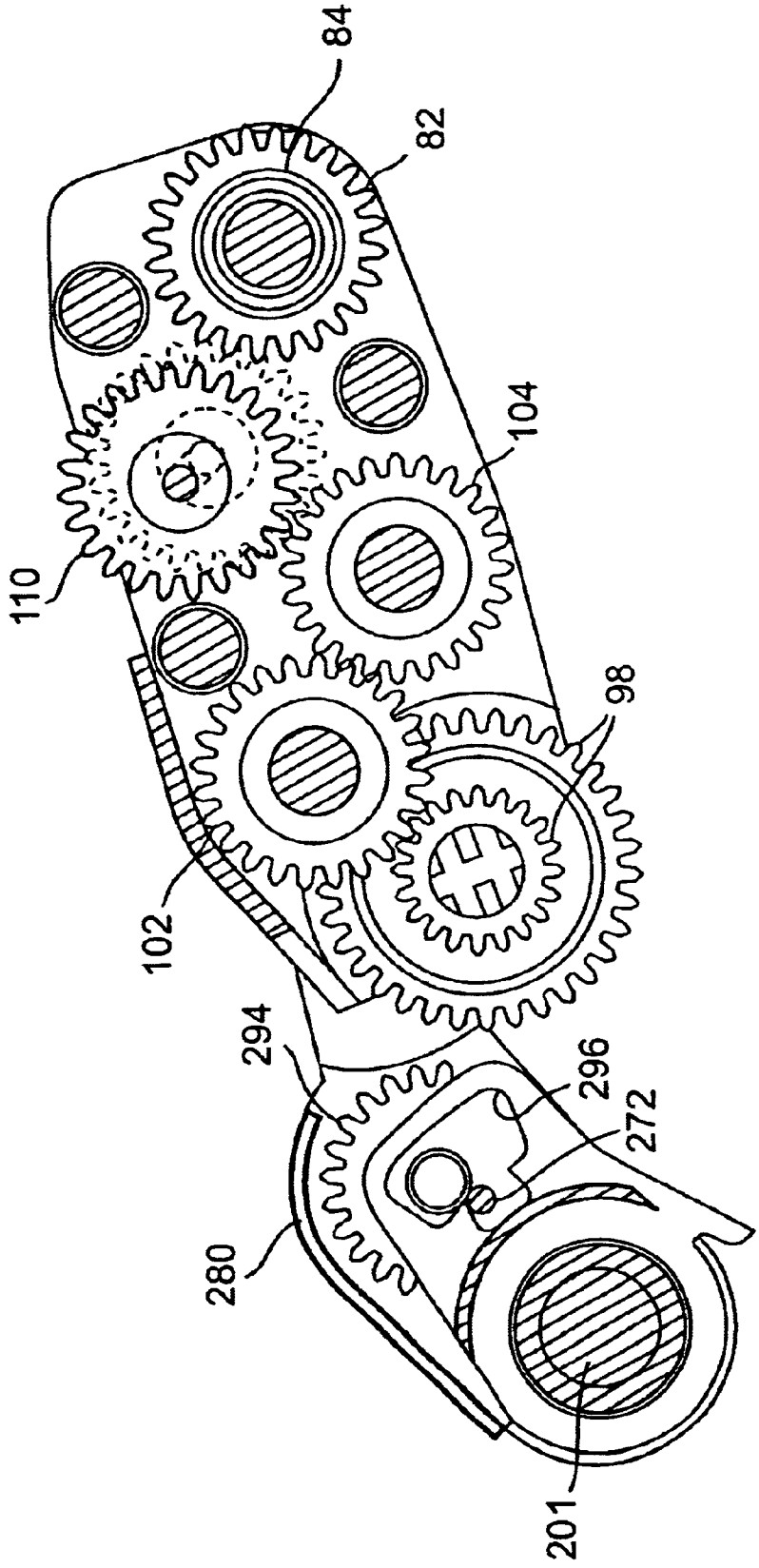

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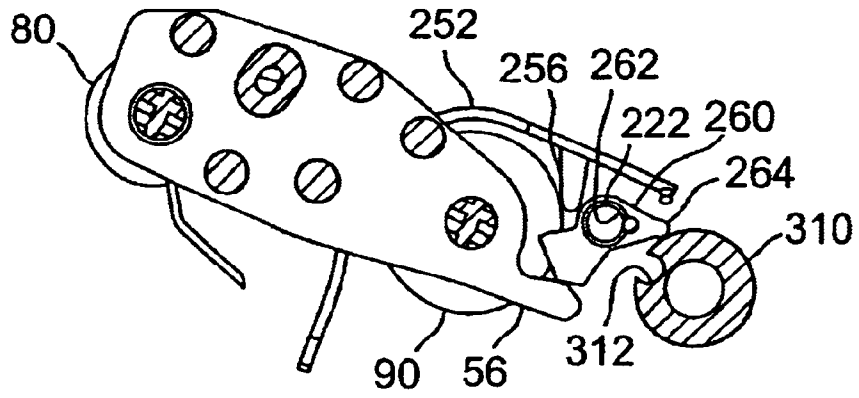


Fig. 16A-1

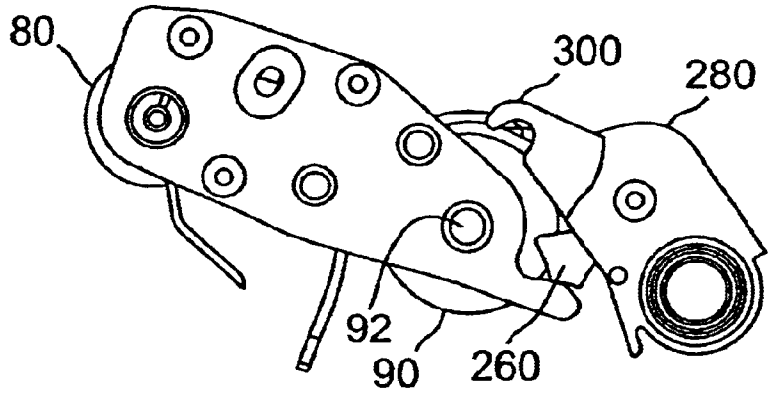


Fig. 16A-2

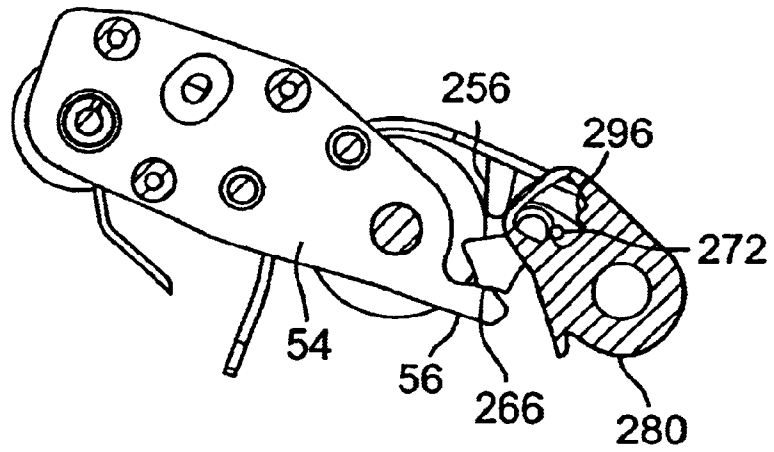
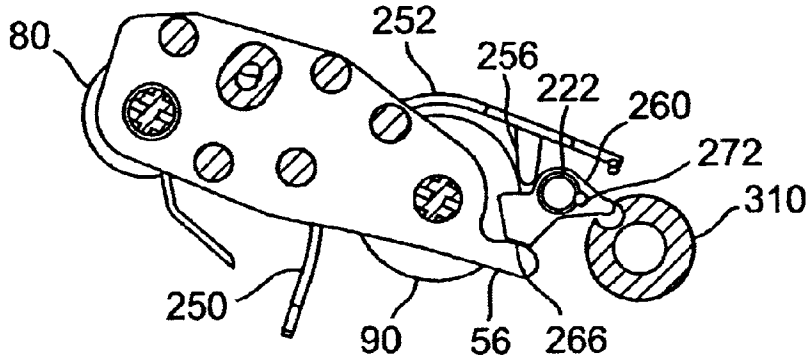


Fig. 16A-3



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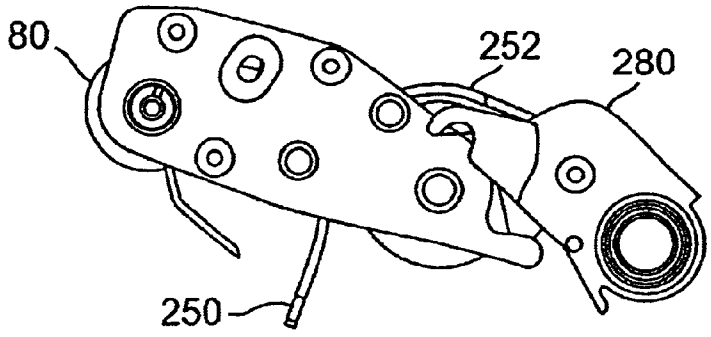
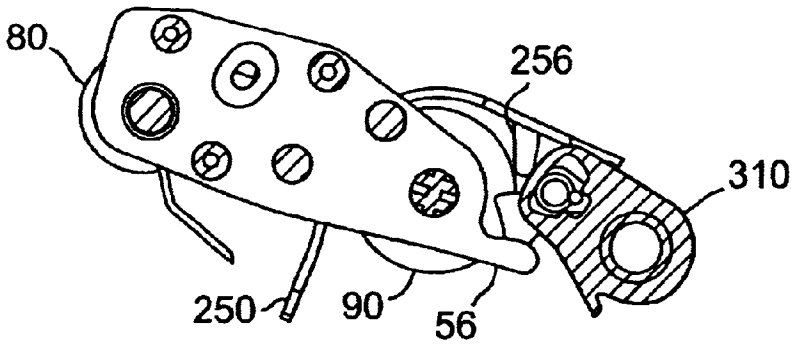


Fig. 16B-2



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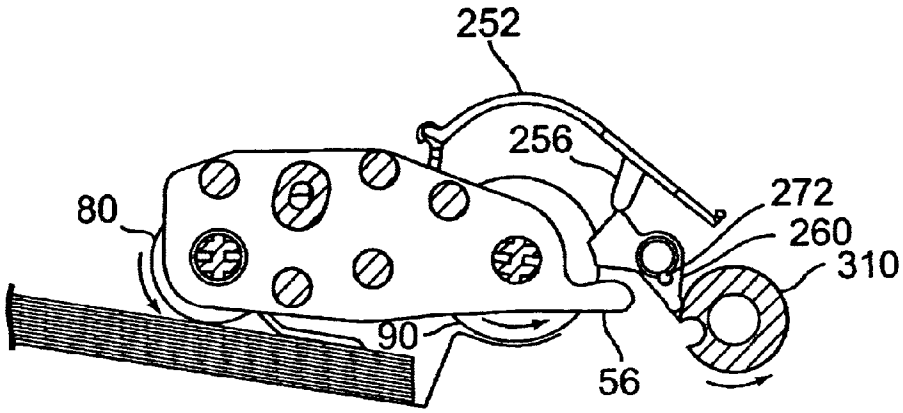


Fig. 16C-1

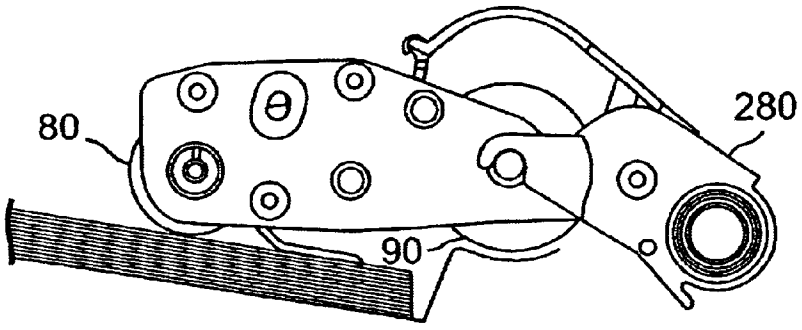


Fig. 16C-2

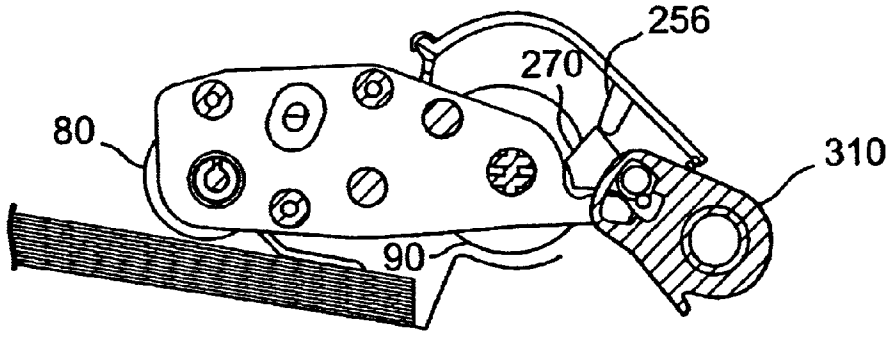


Fig. 16C-3

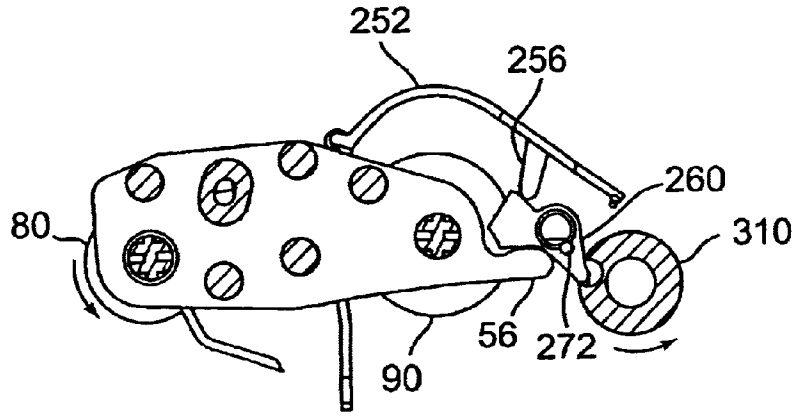


Fig. 16D-1

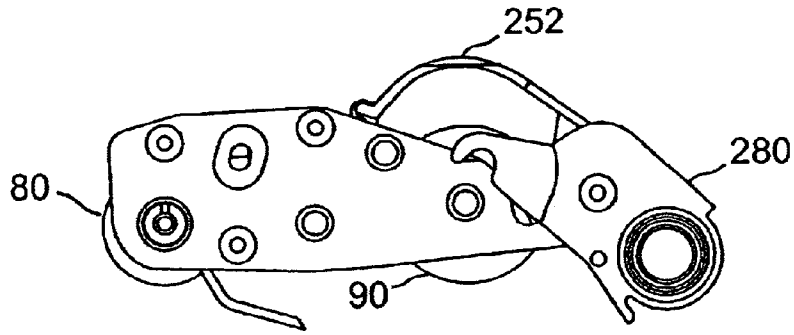


Fig. 16D-2

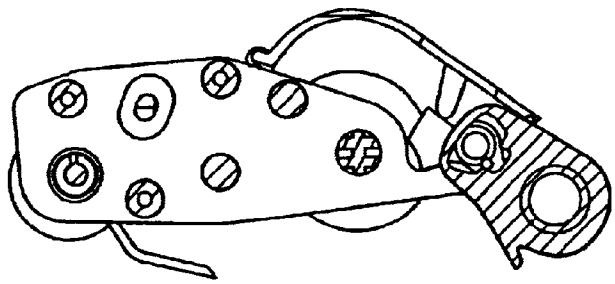


Fig. 16D-3

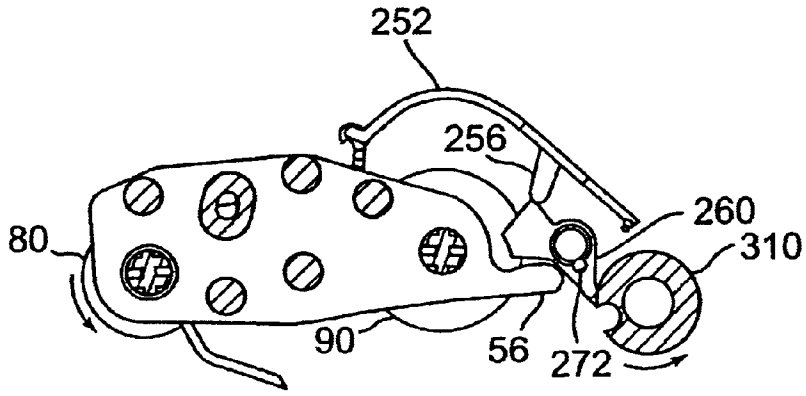
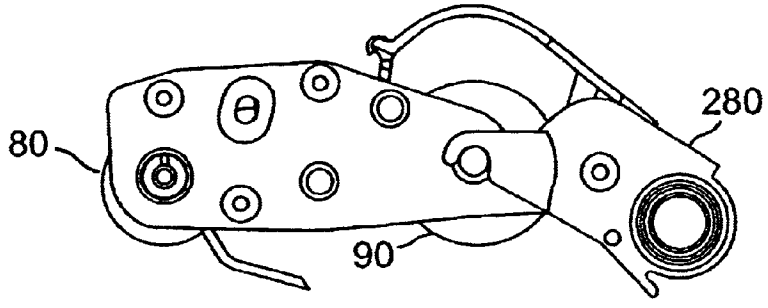


Fig. 16E-1



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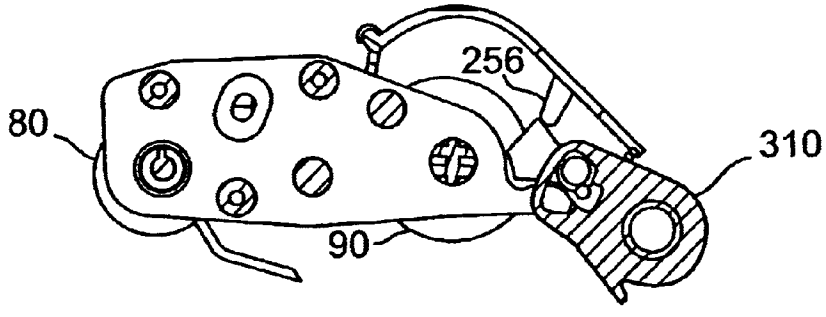

Fig. 16E-3

SHEET FEEDER WITH MODULAR ROLLER SUPPORT AND DRIVE ASSEMBLY

CROSS REFERENCE TO RELATED APPLICATIONS

None.

BACKGROUND OF THE INVENTION

The present invention relates generally to the art of document processing equipment such as scanners, printers, facsimile machines and combination devices which use single sheet feeders to pick single sheets of media to be processed from a stack thereof. Such equipment includes sheet moving rollers, belts or wheels and, in particular, the sheet feeders with which the present invention is concerned employ both a pre-feed roller and a separation roller spaced downstream from the pre-feed roller. A stack stop is positioned to be moved into and out of the path of sheet movement between the rollers. Worn or otherwise damaged rollers in such equipment occasionally require replacement necessitating a service call and attendant expense. It is accordingly desirable to provide a modular single sheet feeder which can be easily assembled at the factory and which also has easily replaceable rollers which can be serviced by the user without the necessity to involve a skilled service technician.

SUMMARY OF THE INVENTION

The present invention therefore provides a sheet feeder comprising:

a) a tray having a support surface and spaced sides defining a sheet delivery path;

b) a roller support assembly pivotally mounted on said tray, said assembly including a frame having a sheet engaging roller and roller drive gears thereon, said roller support and drive assembly including:

1) a shaft extending transversely above said sheet delivery path and a biasing member for rotating said shaft relative to said tray;

2) at least one load arm fixedly attached to said shaft, said frame being pivotally affixed to said load arm, said shaft biasing said frame toward said support surface;

3) a cam coaxially rotatably mounted on said shaft, said cam including a cylindrical surface and an aperture in said surface;

4) a follower pivotally supported on said assembly for rotation about an axis parallel to said shaft, said follower having a finger engageable with said cam surface and said aperture and having a first cam surface engageable with said frame;

5) a swing arm rotatably mounted on said shaft, said swing arm engaging said follower to pivot said follower;

6) an input gear and a clutch gear mounted on said swing arm, said input gear being affixed to said cam and engaged with said clutch gear, said clutch gear being engageable with a roller drive gear on said frame as said swing arm rotates on said shaft in a forward sheet delivery direction, and said swing arm rotating on said shaft to disengage said clutch gear from said roller drive gear when input power is applied in a reverse direction and when a roller is over driven.

The present invention further provides a sheet feeder comprising:

a) a tray having a support surface and spaced sides defining a sheet delivery path; and

b) a roller support assembly which includes a frame having a pre-feed roller and a separation roller mounted thereon, said assembly being pivotally mounted on said tray, said assembly comprising:

1) a shaft extending transversely above said sheet delivery path and a biasing member for rotating said shaft to urge said rollers toward said support surface;

2) at least one load arm fixedly attached to said shaft for pivotally supporting said roller frame;

3) a cam rotatably mounted on said shaft, said cam including a cylindrical surface and an aperture in said surface;

4) a follower pivotally supported on said load arm for rotation about an axis parallel to said shaft, said follower having a finger engageable with said cam surface, said finger being moveable into said aperture during forward rotation of said cam in a sheet delivery direction, said follower having a first follower cam surface engageable with said frame for moving said frame and roller away from said support surface during reverse rotation of said cam, said follower having a second cam surface;

5) a swing arm rotatably mounted on said shaft, said swing arm engaging said follower during said reverse rotation to pivot said follower to remove said finger from said aperture; and

6) a stack stop pivotally mounted on said assembly and engageable by said second cam surface to move said stack stop in a path extending between said pre-feed roller and said separation roller out of a path of movement of a media sheet when said finger is in said aperture during said forward rotation.

The invention further provides a sheet feeder comprising:

a) a tray having a support surface and spaced sides defining a sheet delivery path; and

b) a roller support assembly mounted on said tray, said assembly including a rotary input gear mounted on support structure; and

c) an input gear retainer coaxially mounted on said support structure with said input gear, said retainer having a cylindrical surface which provides a motion limit surface for engagement by a pivotal motor output gear arm to prevent over engagement of teeth on said output gear and said input gear.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a single sheet feeder module which includes a media input tray shown partly in section, a modular roller support assembly, and a removable roller bogie.

FIG. **2** is a top plan view of the sheet feeder module.

FIG. **3** is a cross sectional elevation taken at line **3**—**3** on FIG. **2**.

FIG. **4** is an exploded perspective view of the bogie.

FIG. **5** is a plan view of the bogie.

FIG. **6** is a cross sectional elevation of the bogie taken at line **6**—**6** on FIG. **5** showing a stack damper on the bogie.

FIG. **7** is a right side elevation of the bogie.

FIG. **8A** is a cross sectional elevation of the bogie taken at line **8**—**8** on FIG. **5** showing the gear cluster and disengaged pre-feed roller clutching gear.

FIG. **8**B is a cross sectional elevation of the bogie like FIG. **8**A showing the engaged position of the pre-feed roller clutching gear.

FIG. **9** is a plan view of the modular roller support assembly and bogie removed from the sheet feeder module.

FIG. **10** is a perspective view of the modular roller support assembly.

FIG. **11** is a cross sectional elevation of the modular roller support assembly taken at line **11**—**11** on FIG. **9** showing the bogie lifting handle.

FIG. **12** is a cross sectional elevation taken at line **12**—**12** on FIG. **9** showing a bogie support load arm.

FIG. **13** is a cross sectional elevation taken at line **13**—**13** on FIG. **9** showing the bogie latch and the stack stop.

FIG. **14** is a cross sectional elevation taken at line **14**—**14** on FIG. **9** showing the main clutch gear disengaged from the separation roller drive gear.

FIG. **15** is a cross sectional elevation taken at line **15**—**15** on FIG. **9** showing the follower engagement with the swing arm.

FIGS. **16**A–**16**E show five positions of the bogie and stack stop as controlled by different positions of a cam follower moved by a cam and by a swing arm.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The modular sheet feeder **10** seen in the perspective view in FIG. **1** is a separate unit of a document processing apparatus which includes a document processing module (not shown) such as a printer, scanner, facsimile machine or copier or combination of any of the foregoing. The sheet feeder module **10** is affixed to the document processing module (not shown) for feeding individual sheets from the top of a stack thereof to sheet transporting mechanism in the document processing module.

The sheet feeder module **10** is comprised of an input tray comprising an input frame **20** having a stack support surface **22** and spaced sides **24**, **26** in the form of upstanding walls which define a sheet transport path for moving individual sheets from the top of a stack supported on a stack support surface **22** from left to right as seen in FIG. **1**. The side wall **24** includes a shaft mounting cradle having a non-circular gate **28** and an integrally formed spring mounting post **30** for purposes which will be described. The other side wall **26** is provided with a bushing aperture **32** located in a motor support plate **34** attached by suitable fasteners to the wall **26**. A reversible electric step motor **35** is supported on the motor support plate **34** which, with the wall **26**, defines a housing for the motor and motor output gear (not shown).

The input frame **20**, which may be of molded plastic as is conventional, includes a stack retard wall **36** which is angled upwardly and away from the stack support surface **22** and with a retard pad **38** positioned for engagement with the arcuate surface of a single sheet separation roller **90** and with a pad **40**, preferably of cork, for engagement with a sheet pre-feed roller **80**. As used herein, the term 'roller' includes single and multiple rollers and spaced or adjacent coaxially mounted wheels and equivalents for moving single sheets of media such as moveable belts trained around spaced rollers.

A roller assembly, which may comprise a replaceable bogie, best seen in FIG. **4**, comprises a frame **50** formed of spaced side members or plates **52**, **54** joined by a cross piece **60** to support a pre-feed roller **80** and a single sheet separation roller **90** downstream of the pre-feed roller **80**, supported on the frame **20**. Side plate **54** has an integrally formed tail or lever arm **56** which extends generally parallel to a line connecting the centers of rotation of the pre-feed roller **80** and single sheet separation roller **90**. The side plates **52**, **54** include bearing apertures **62**, **64** for a pre-feed roller support shaft and bearing apertures **66**, **68** for a separation roller support axle **92**. A gear retainer plate **70** is mounted on and spaced from side plate **54** by spacing posts **74** and fasteners **76**. A pre-feed roller clutch gear shaft slot **58** in side plate **54** aligns with a pre-feed roller clutch gear shaft mounting slot **72** in the gear retainer **70**.

The sheet pre-feed roller **80** is supported on a shaft **81** whose ends are received in the apertures **62**, **64** in the side plates **52**, **54**, respectively. As is conventional, the pre-feed roller has an elastomeric surface or a surface texture suitable for engaging the top surface of a sheet to be removed from the stack. Similarly, the single sheet separation roller **90** is supported on an axle **92** the ends of which are received in the bearing apertures **66**, **68** in the side plates **52**, **54**. In sheet transporting position, the separation roller **90** forms a sheet separation nip with a surface of the retard pad **38**. The separation roller axle **92** has spaced support bearings **94**, **96** thereon for a purpose to be described and a separation roller drive gear **98** is also mounted on the axle **92** for driving the separation roller **90**. A plurality of intermediate gears **102**, **104** may be provided to transmit power from the rotating separation roller **90** to rotate the pre-feed roller **80** through a pre-feed roller clutch gear **110** which preferably has elastomeric teeth permanently engaged with the separation roller drive gear **98** or with one of the intermediate gears. The clutch gear **110** is supported on a shaft, the ends of which are received in the slots **58**, **72** which are preferably arcuate and are centered on the axis of rotation of a drive or intermediate gear which is continually engaged with the clutch gear **110**.

A stack damper **120** is freely rotatable on the pre-feed roller support shaft **81**, the stack damper having a surface which extends in the downstream direction of sheet movement from the pre-feed roller **80** parallel to the surface of a stack of media sheets on the support surface **22**. The stack damper **120** is heavy enough to prevent buckling of thin sheets between the pre-feed roller **80** and the separation roller **90** and is free to pivot upwardly by sheet contact, particularly with heavy sheets, until it engages a stop surface on the frame such as the cross piece **60** as seen in FIG. **6**. The roller frame **50** thus supports the pre-feed roller **80**, single sheet separation roller **90**, gears and stack damper **120**, if provided, which together comprise a replaceable bogie which is supported by a modular roller support and drive assembly **200** to be described.

The modular roller support and drive assembly **200** best seen in FIGS. **9** and **10** is comprised of a shaft **201** received in axially aligned shaft supports in the spaced side walls **24**, **26** of the input tray **20**. One of the shaft supports comprises the bushing aperture **32** into which one end of the shaft is inserted as the other end of the shaft, having a part non-circular configuration, is rotated to the appropriate position to be dropped into the other support through the non-circular shaft mounting slot **28**. The shaft also has a transversely extending spring arm **202** non-rotatably affixed to the shaft, the arm **202** having a spring retainer or boss **204** protruding therefrom. A biasing member, preferably a tension spring **206**, is connected between the spring retainer **30** on the side of the input tray and the boss **204** on the spring arm **202**. The spring **206** passes over the center axis of the shaft **201** as the spring is tensioned.

The roller assembly **50** in the form of a replaceable bogie is supported between a pair of spaced bogie support load

arms **210, 212** non-rotatably affixed to the shaft **201** as seen in FIGS. **9** and **10**. The bogie support arms preferably also include spaced axially aligned support hubs **214** (FIGS. **1** and **13**) for supporting a stack stop link **252**. The load arms **210, 212** also preferably have spaced transversely extending stack stop guides **216** thereon and are provided with aligned bogie support apertures or slots **218, 220** in which the spaced bearings **94, 96** on the separation roller axle **92** are received to support the removable bogie on the modular roller support and drive assembly **200**. A bogie retention latch **230** having a release button **232** and spaced latch hooks **234** is pivotally mounted between the bogie support arms **210, 212**, the latch being biased to closed position by a bogie latch spring **236** seated between the bogie latch button and a transverse brace **211** which extends between and is connected to the load arms **210, 212**. The latch hooks **234** engage the bogie support arms when the latch is closed to avoid clamping of the latch hooks onto the bearings **94, 96** of the separation roller axle **92**.

A bogie lifting handle **240** is preferably also provided, the handle **240** being non-rotatably affixed to the support shaft **201**. As seen in FIG. **11**, the lifting handle is biased to a downward position by a spring **242** engaged with a seat on the load arm **210** so that lifting of the handle **240** first compresses the spring **242** before lifting the load arms **210, 212** and attached bogie. The compression spring **242** also biases the bogie downwardly through contact of the end of the handle **240** with the upper surface of the bogie frame as seen in FIGS. **1** and **10** providing the force on the pre-feed roller **80** in the media feed position and urging the frame tail or lever arm **56** upwardly against a cam surface of a follower **260** (FIGS. **14** and **16**) to be described, when the follower has lifted the bogie to the up positions. The lifting handle **240** and tension spring **206** are designed with over center geometry so that the spring **206** will bias the replaceable roller assembly or bogie **50** downwardly for sheet feeding and will hold the handle and bogie in the lifted position to facilitate removal of jammed sheets and inspection of the paper path.

As seen in FIGS. **3, 13** and **16**, a stack stop **250** comprising a substantially rectangular plate which is vertically guided between the stack stop guides **216** is pivotally connected to and extends from a stack stop link **252** downwardly between the pre-feed roller **80** and single sheet separation roller **90**. The stack stop link **252** is pivotally attached to and supported between the spaced load arms **210, 212** such that the stack stop **250** is movable into and out of the path of movement of a media sheet downstream of the pre-feed roller **80** and upstream of the single sheet separation roller **90**. A downwardly extending leg **256** is integrally formed on the stack stop link **250** for engagement with a follower **260** to lift and lower the stack stop **250**.

As seen best in FIG. **16**, the follower **260**, having a pivot aperture **262** therein is pivotally mounted on a follower support post **222** received in the aperture **262**, the post extending outwardly from the load arm **212** in a direction parallel to the axis of the support shaft **201**. The follower **260** has a point **264** and a cylindrical first cam surface **266** (FIG. **16A-3**) which engages the bogie tail lever arm **56** as the follower **260** pivots on its support post to partly raise the bogie and pre-feed roller **80** supported thereon relative to the stack support surface **22** in the tray **20** when a stack of sheets is to be inserted against the stack stop **250**. The follower **260** also has a second cam surface **268** (FIG. **16A-3**) which engages the leg **256** on the stack stop link **252** for raising and lowering the stack stop into and out of sheet blocking position. A third cam surface **270** (FIG. **16C**) on the follower **260** is provided for engagement with the bogie tail lever arm **56** and is used for test purposes not relevant herein when the single sheet feeder module is not installed on the document processing module. The follower **260** also includes an axially protruding portion in the form of a pin **272** for a purpose to be described.

As seen in FIGS. **10, 14** and **16**, modular roller support and drive assembly **200** also includes a swing arm **280** axially supported on the shaft **201** for rotation relative to the shaft **201** by spaced swing arm supports **284, 286**. A power input gear assembly **290** having axially spaced gears **291** affixed to opposite ends of a sleeve **292** is mounted on the support shaft **201**. One of the axially spaced gears **291** receives input power from an automatic direction finding gear drive (not shown) driven by the motor **35**. The other of the axially spaced gears **291** on the input gear assembly **290** is continuously engaged with a clutch gear **294** supported on the swing arm **280**. A drag spring for the clutch gear **294** may also be provided. A pocket **296** seen in FIGS. **16(3)** in the side face of the swing arm **280** receives the pin **272** on the follower so that rotation of the swing arm on shaft **201** lifts the follower **260** when the input gear assembly **290** is rotated in the reverse direction of rotation by the motor **35**. A motion limit hook **300** is also integrally formed on the swing arm **280** for engagement with the protruding end of the separation roller axle **92** to provide over-engagement protection between the teeth of the main clutch gear **294** and the separation roller drive gear **98** and to restrain lifting of the bogie frame **50**.

As seen in FIGS. **2** and **16**, a rotary cam Geneva **310** is also affixed to the input gear assembly **290** and is positioned on the remote side of the swing arm **280** from the gears **291** and in alignment with the follower **260** so that the point **264** on the follower engages a cylindrical surface of the cam and is permitted to enter an aperture **312** in the cylindrical surface of the cam **310** when the cam rotates in the forward or counterclockwise direction as seen in FIG. **16(1)**. Reverse rotation of the input gear assembly **290** causes the cam **310** to lift the point **264** from the aperture **312** to raise the bogie and lower the stack stop **250** for insertion of a new stack of media sheets.

The swing arm **280** and input gear assembly **290** including the cam Geneva **310** which are all rotatably supported on the shaft **201**, are retained on the shaft by a retainer **320** suitably affixed to the shaft to axially position one of the input gears **291** in alignment with the motor output gear **293** and the other gear **291** is positioned for engaging the clutch gear **294** supported on the swing arm **280**. As seen in FIG. **10**, the retainer **320** has an arcuate, preferably cylindrical, surface **322** adjacent to the input gear **291** in a position such that the cylindrical surface **322** will be engaged by a motor output gear support **295** which moves the motor output gear **293** into and out of engagement with the input gear **291** to prevent over engagement of the motor output gear and the input gear **291**. The retainer **320** may be held in position on the shaft **201** by a snap spring seated in a properly axially positioned circumferential groove on the shaft **201** or by any other suitable means. A split sleeve **330** made of resilient plastic is snapped onto the other end of the shaft **201** adjacent the bogie lifting handle **240** to provide proper positioning of the lifting handle **240**.

Operation

A stack of media sheets is inserted into the sheet feeder beneath the pre-feed roller **80** which is initially positioned at a distance above the stack support surface **22** to permit stack insertion until the leading edge of the stack engages the stack stop **250**. Application of input power in the forward direction

to the input gear assembly **290** then rotates the Geneva cam **310** and aperture **312** to a position which permits the follower finger **264** to drop into the cam aperture **312**. Continued forward rotation of the motor then lifts the stack stop **250** and drops the bogie and roller **80** into sheet transporting position. The pre-feed roller **80** is under driven relative to the separation roller **90** which subsequently is under driven with respect to the sheet moving rollers in the document processing module (not shown) such that sheets are pulled through the feeder. In addition, both the pre-feed roller **80** and the separation roller **90** are clutch driven to allow them to be over driven by the media sheet. The pre-feed roller drag spring **84** places drag on the pre-feed roller drive gear to permit dwell to be built up in the prefeed roller **80**. The pre-feed roller **80** is under driven so that dwell can be accumulated during advancement of the sheet of media, the dwell then being consumed after the trailing edge of one sheet leaves the pre-feed roller **80**. This dwell then allows the pre-feed roller to remain stationary so that a second sheet will also remain stationary until the trailing edge of the first sheet has just left the nip defined between the separation roller **90** and the tray **20**.

Since the separation roller **90** must be under driven relative to the downstream document processing rollers (not shown) the separation roller **90** needs to be clutched in an overdrive situation to prevent abnormally high back tension from the sheet feeder module and unnecessary parasitic torque losses in the drive system caused by a sheet of paper pulled by the downstream document processing module rollers. The clutch gear **294** for the separation roller **90** therefore needs to engage when the bogie is in the down position. Also, the stack stop **250** must be in the up position whenever the rollers **80, 90** are driven to transport a sheet of media. Conversely, the clutch gear **294** for the separation roller **90** is disengaged when the bogie is up, the stack stop is down, and the system is dormant. The separation roller clutch gear **294** also allows the separation roller to free wheel when the sheet is being pulled down downstream by the document processing module rollers.

The follower finger **264** is always urged against the cylindrical surface of the Geneva cam **310** due to bias by the tail lever arm **56** on the bogie frame **50** on the cam surface **266** of the follower **260**. Although a compression spring **242** engaged with the lifting arm provides this bias, various alternatives can easily be envisioned by those skilled in the art. The point on the end of finger **264** is therefore urged into the aperture **312** whenever the aperture rotationally passes in the forward direction past the finger **264** but the aperture in the cam **310** is curved to prevent entry of the point into the aperture when the cam **310** continues to rotate in the same direction after the finger **264** has exited the aperture **312**. This provides four stable operational positions of the follower:

1. Stack Insertion or Up-Up—The pre-feed roller **80** is spaced from the input tray and the follower **260** and protruding pin **272** are in the up position and the point **264** engages the cylindrical surface of the cam **310** anticipating passage of the slot as seen in FIG. **16A(1)**. The follower **260** is upwardly biased by the bogie tail lever arm **56**. The coefficient of friction between the engaged surfaces of the follower and lever arm must be low enough to ensure that the lever arm urges the follower point **264** toward the surface of the cam **310**. The swing arm **280** is also in the up position as seen in FIGS. **16A(2** and **3)** and a lower wall of swing arm pocket **296** is engaged with the pin **272**.
2. Up-Down—The pre-feed roller **80** is still spaced from the input tray since the follower **260** is in the up position but the point **264** has moved into the aperture **312** as seen in FIG. **16B(1)**. It is to be noted that the point **264** enters the aperture **312** only when the cam is rotated in the reverse direction (counterclockwise as seen in FIG. **16)**. The first cam surface **266** on the follower allows the follower to maintain in a stable up-down state without jumping to one of the following positions. The swing arm **280** has commenced downward movement as seen in FIGS. **16B(2** and **3)** and an upper wall of the pocket **296** now engages the pin **272**.
3. Operational State—This position seen in FIGS. **16C (1–3)** is used to pre-feed a document from the input stack and present it to the separation nip and then drive the sheet to the scanning region of the apparatus. The pre-feed roller **80** rests on top of the input stack of media and is downwardly biased with sufficient sheet picking force by the handle **240**. The follower and stack stop are in the same position as in the down states but there is clearance between the follower surface **270** and the tail lever arm **56**. This allows all of the force from the lifting handle **240** to load the pre-feed roller against the input stack. The swing arm is down and engaged and the bogie clutch gear is engaged. Rotational power input then rotates the rollers **80, 90** in the forward direction.
4. Down-Up—This position is used when testing the modular roller support and drive assembly **200**. The pre-feed roller **80** is in the down position as cam **310** is rotated in the reverse direction and the follower point **264** has entered the aperture **312** in the cam **310** due to engagement of the tail lever arm **56** with the first cam surface **266** of the follower pushing the point up into the aperture **312** as seen in FIG. **16D(1)**. The swing arm **280** is in the up and disengaged position as seen in FIGS. **16D(2** and **3)** when the input is rotating in the reverse (clockwise) direction. There is enough space in the pocket **296** to allow the swing arm to rotate down into the engaged position if the input power is applied in the forward (counterclockwise) direction.
5. Down-Down—The pre-feed roller **80** and follower **260** are down and the point **264** is ready to enter the aperture **312** in the cam Geneva as seen in FIG. **16E(1)**. The swing arm **280** is also in the down position as seen in FIGS. **16E(2** and **3)**.

The second cam surface **268** on the follower engages the leg **256** of the stack stop link **252** to raise the stack stop **250** when the follower rotates to the down position seen in FIGS. **16D** and E. When the follower **260** rotates to the up position, the stack stop link and stack stop are lowered as seen in FIGS. **16A** and B.

Engagement of the follower pin **272** by the walls of the swing arm pocket **296** ensures that when the follower **260** is in the up position the bogie is also up and the stack stop **250** is in the down position and the main clutch gear **294** on the swing arm is not engaged with the separation roller drive gear **98**. Thus, the system is in "neutral" so that the input gear assembly **290** can rotate indefinitely in the reverse direction without engagement of the drive train for the rollers **80, 90**.

The drag spring **295** for the main clutch gear **294** gives the clutch gear a propensity to engage when rotating in the forward direction and the motion and the impetus to disengage when the clutch gear rotates in the reverse direction. This impetus is transferred to the pin **272** on the follower by the surfaces of the pocket **296** on the swing arm. There is adequate spacing between the pocket surfaces such that some over travel of the swing arm **280** is permitted for the

overrunning clutching purposes previously explained. The surfaces of the pocket **296** are angled such that they rotate the follower about its pivotal support post **246** with the maximum amount of engagement of the point **264** with the Geneva cam **310**.

The stack damper **120** on the bogie frame **50** is preferably made of plastic and has a weight heavy enough to constrain thin media sheets driven by pre-feed roller **80** to prevent buckling in the area between the pre-feed roller **80** and the separation roller **90**, yet light enough to prevent it from buckling between the pre-feed roller **80** and stack damper **120**. The stack damper **120** is also stopped in its upward travel to impart a slight bend to thick media sheets during sheet movement imparted by the pre-feed roller **80**. The stack damper **120** falls after each sheet passes to beat down subsequent sheets of media that may be climbing up the inclined retard wall **36** reducing the tendency for more than just a few sheets to thereafter be driven over the top of the wall **36**. The stack damper **120** rests by gravity on top of the top sheet of media. The bottom surface of the stack damper **120** is tangential to the outer drive surface of the pre-feed roller **80** to ensure that the surface of the stack damper is always in flat contact with the top sheet of the input stack regardless of the height of the input stack. The physical engagement of the stack damper **120** with a very stiff sheet to slightly bend it thus prevents it from moving straight from the input stack over the crest of the retard wall **36**, scrubs off additional sheets from climbing over the top edge of the retard wall **36** and initiates proper form to a stiff sheet by providing a bend orthogonal to the direction of movement of the sheet. This eliminates sheet curl and other discontinuities that may exist in an axis parallel with the direction of movement of the sheet that can disturb single sheet separation.

The modular roller support and drive assembly **200** can easily be assembled to and removed from the tray **20** by detaching the spring **206**. The support shaft **201** can then be rotated to the proper position so that it can be removed from its supports in the side walls of the tray **20**. The mounting of the entire roller support and drive assembly **200** on a single support shaft **201** enables accurate alignment, loading and positioning of the various structural pieces mounted on the shaft.

The pre-feed roller clutch gear **110** is preferably made of elastomeric material or has elastomeric teeth thereon for quiet operation. The clutch gear **110** is supported on an axle received in slots **58**, **72**, the bottom saddle of which prevents over engagement of the clutch gear with the pre-feed roller drive gear **82**. When the pre-feed roller **80** is over driven, the clutch gear **110** moves upwardly until its teeth disengage from the pre-feed roller drive gear **82**. The slots are angled or preferably arcuate such that the clutch gear never disengages from the intermediate drive gear with which it is engaged. The use of elastomeric teeth on the clutch gear **110** has been found to significantly reduce objectionable clicking noises created, when clutching gears made out of hard plastic materials are moved into engagement with the driven gear.

Persons skilled in the art will also appreciate that various additional modifications can be made in the preferred embodiment shown and described above and that the scope of protection is limited only by the wording of the claims which follow.

What is claimed is:

1. A sheet feeder comprising:

a) a tray having a support surface and spaced sides defining a sheet delivery path;

b) a roller support assembly pivotally mounted on said tray, said assembly including a frame having a sheet engaging roller and roller drive gears thereon, said roller support assembly including:

1) a shaft extending transversely above said sheet delivery path and a biasing member for rotating said shaft relative to said tray;

2) at least one load arm fixedly attached to said shaft, said frame being pivotally affixed to said load arm, said shaft biasing said frame toward said support surface;

3) a cam coaxially rotatably mounted on said shaft, said cam including a cylindrical surface and an aperture in said surface;

4) a follower pivotally supported on said assembly for rotation about an axis parallel to said shaft, said follower having a finger engageable with said cam surface and said aperture and having a first cam surface engageable with said frame;

5) a swing arm rotatably mounted on said shaft, said swing arm engaging said follower to pivot said follower;

6) an input gear and a clutch gear mounted on said swing arm, said input gear being affixed to said cam and engaged with said clutch gear, said clutch gear being engageable with a roller drive gear on said frame as said swing arm rotates on said shaft in a forward sheet delivery direction, and said swing arm rotating on said shaft to disengage said clutch gear from said roller drive gear when input power is applied in a reverse direction and when a roller is over driven.

2. The sheet feeder of claim **1**, further comprising a second load arm fixedly attached to said shaft, said frame being pivotally supported on and between said load arms.

3. The sheet feeder of claim **2**, wherein said finger is received in said aperture in said cam as said cam is driven in reverse direction to pivot said follower and frame away from engagement with said tray.

4. The sheet feeder of claim **3**, wherein said frame includes a lever arm engageable with said follower for biasing said follower in a direction to urge said finger into engagement with said cam surface.

5. The sheet feeder of claim **4**, wherein said finger includes a point for entry into said aperture and said cam aperture is curved to prevent entry of said point into said aperture when said cam continues to rotate in one direction after said point has exited said aperture.

6. The sheet feeder of claim **3**, further comprising a motion limit stop on said swing arm and a motion limit stop on said frame, said stop on said swing arm engaging said limit stop on said frame to prevent over engagement of said clutch gear on said swing arm with said roller drive gear.

7. The sheet feeder of claim **6**, wherein said motion limit stop on said frame is aligned with the axis of rotation of said roller drive gear.

8. The sheet feeder of claim **3**, further comprising an input gear retainer mounted on said shaft, said retainer having a cylindrical surface which provides a motion limit surface for a pivotal motor output gear support to prevent over engagement of teeth on said output gear and teeth on an input gear.

9. The sheet feeder of claim **3**, wherein said rollers on said frame include a pre-feed roller and a separation roller.

10. The sheet feeder of claim **9**, further comprising a stack stop pivotally mounted on said assembly and engageable by said follower to pivotally move said stack stop in a path extending between said pre-feed roller and said separation roller into and out of the path of movement of a media sheet.

11. The sheet feeder of claim **10**, wherein said stack stop is in sheet blocking position when said drive gear is disengaged from said separation roller drive gear and is in sheet passing position when said drive gear is engaged with said separation roller drive gear.

12. The sheet feeder of claim **11**, wherein said stack stop comprises a stop member and a link member pivotally connected to said stop member, said link member having a leg which engages said follower.

13. The sheet feeder of claim **10**, wherein said tray includes shaft supports for receiving said shaft whereby said media roller support and drive assembly is removable as a module from said tray.

14. The sheet feeder of claim **13**, wherein said shaft supports comprise a bearing aperture for receiving one end of said shaft and a cradle having a non-circular opening for receiving a non-circular collar on said shaft when said shaft is rotated to an assembly module removal position.

15. The sheet feeder of claim **14**, wherein said roller support and drive assembly further comprises a lifting handle fixedly attached to said shaft for manually rotating said roller support and drive assembly relative to said tray.

16. The sheet feeder of claim **15**, wherein said biasing member comprises a tension spring connected to said tray and to a spring arm affixed to said shaft.

17. The sheet feeder of claim **16**, wherein said tension spring is connected to said tray and spring arm such that said tension spring crosses the centerline of said shaft to hold said roller support and drive assembly in an inoperative position for inspection of said sheet delivery path.

18. The sheet feeder of claim **2**, wherein said load arms have frame support slots therein which receive frame support bearings aligned with the axis of rotation of said separation roller.

19. The sheet feeder of claim **18**, wherein said roller frame, said rollers and said gears mounted on said roller frame comprise a replaceable bogie supported by said load arms.

20. The sheet feeder of claim **19**, further comprising a bogie latch pivotally mounted on said load arms, said latch including spaced latch hooks for holding axially aligned bearings on said separation roller in said support slots on said load arms.

21. The sheet feeder of claim **20**, further comprising a spring biasing said hooks toward said slots.

22. The sheet feeder of claim **21**, wherein said hooks engage said frame to prevent said latch from clamping said separation roller.

23. The sheet feeder of claim **20**, further comprising a manually accessible release button on said latch for pivoting said latch relative to said load arms to release said bogie.

24. The sheet feeder of claim **11**, further comprising a frame positioning lever extending from said frame in a direction generally parallel to and spaced from a line connecting the axes of rotation of said rollers, said follower having a first cam surface which engages said lever to position said frame relative to said input tray.

25. The sheet feeder of claim **24**, wherein said follower includes a second cam surface for testing said media roller support and drive assembly module.

26. A sheet feeder comprising:

a) a tray having a support surface and spaced sides defining a sheet delivery path; and

b) a roller support assembly which includes a frame having a pre-feed roller and a separation roller mounted thereon, said assembly being pivotally mounted on said tray, said assembly comprising:

1) a shaft extending transversely above said sheet delivery path and a biasing member for rotating said shaft to urge said rollers toward said support surface;

2) at least one load arm fixedly attached to said shaft for pivotally supporting said roller frame;

3) a cam rotatably mounted on said shaft, said cam including a cylindrical surface and an aperture in said surface;

4) a follower pivotally supported on said load arm for rotation about an axis parallel to said shaft, said follower having a finger engageable with said cam surface, said finger being moveable into said aperture during forward rotation of said cam in a sheet delivery direction, said follower having a first follower cam surface engageable with said frame for moving said frame and roller away from said support surface during reverse rotation of said cam, said follower having a second cam surface;

5) a swing arm rotatably mounted on said shaft, said swing arm engaging said follower during said reverse rotation to pivot said follower to remove said finger from said aperture; and

6) a stack stop pivotally mounted on said assembly and engageable by said second cam surface to move said stack stop in a path extending between said pre-feed roller and said separation roller out of a path of movement of a media sheet when said finger is in said aperture during said forward rotation.

27. The sheet feeder of claim **26**, wherein said follower includes a pin and said swing arm includes a pocket which receives and engages said pin to pivot said follower to remove said finger from said aperture.

28. The sheet feeder of claim **27**, wherein said assembly includes a roller drive gear, an input gear and a clutch gear on said swing arm, said input gear being affixed to said cam and being engaged with said clutch gear, said clutch gear engaging said roller drive gear as said swing arm rotates on said shaft during application of power in said forward direction, said swing arm rotating on said shaft to disengage said clutch gear from said roller drive gear when power is applied in said reverse direction, said stack stop being in sheet blocking position when said clutch gear is disengaged from said roller drive gear and being in sheet passing position when said clutch gear is engaged with said roller drive gear.

29. The sheet feeder of claim **28**, wherein said stack stop comprises a stop member and a link member pivotally connected to said stop member, said link member having a leg which engages said follower.

30. A sheet feeder comprising:

a) a tray having a support surface and spaced sides defining a sheet delivery path; and

b) a roller support assembly mounted on said tray, said assembly including a rotary input gear mounted on a support structure; and

c) an input gear retainer coaxially mounted on said support structure with said input gear, said retainer having a cylindrical surface which provides a motion limit surface to prevent over engagement of teeth on an output gear and said input gear while said input gear is driving said roller support assembly, the motion limit surface located adjacent the input gear and comprising an arcuate shape configured for engagement by a motor output gear support which moves the output gear into and out of engagement with the input gear.

31. The sheet feeder of claim **30**, wherein said retainer is positioned adjacent said input gear.

32. The sheet feeder of claim 31, wherein said support structure comprises a shaft and said input gear and said retainer are rotatably mounted on said shaft.

33. A document processing apparatus comprising a document processing module and a sheet feeding module removably affixed to said document processing module, said sheet feeding module comprising the sheet feeder of claim 1.

34. The document processing apparatus of claim 33, wherein said document processing module includes a printer.

35. The document processing apparatus of claim 34, wherein said printer is an inkjet printer.

36. The document processing apparatus of claim 33, wherein said document processing module includes a facsimile machine.

37. The document processing apparatus of claim 33, wherein said document processing module includes a document scanner.

38. A document processing apparatus comprising a document processing module and a sheet feeding module removably affixed to said document processing module, said sheet feeding module comprising the sheet feeder of claim 26.

39. The document processing apparatus of claim 38, wherein said document processing module includes a printer.

40. The document processing apparatus of claim 39, wherein said printer is an inkjet printer.

41. The document processing apparatus of claim 38, wherein said document processing module includes a facsimile machine.

42. The document processing apparatus of claim 38, wherein said document processing module includes a document scanner.

43. A sheet feeder having an input gear affixed to a shaft, said input gear being engageable with a motor driven output gear for transmitting bi-directional input power delivered by said motor driven output gear to at least one sheet feeder roller, a motion limiter mounted on said shaft proximate said input gear, said motion limiter having an arcuate surface to prevent over engagement of an output gear with said input gear while said input gear is driving said roller support assembly, the motion limit surface located adjacent the input gear and comprising said arcuate surface having a cylindrical shape, configured for engagement by a motor output gear support which moves the output gear into and out of engagement with the input gear.

44. The sheet feeder of claim 43, wherein said motion limiter comprises an input gear retainer for retaining said input gear in desired axial position on said shaft.

45. The sheet feeder of claim 44, wherein said motion limiter is non-rotatably affixed to said shaft alongside said input gear.

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